

Open Research Online

The Open University's repository of research publications and other research outputs

MArket Demands that Reward Investment in Design (MADRID). Final Report

Other

How to cite:

Roy, Robin; Riedel, Johann C. K. H. and Potter, Stephen (1998). MArket Demands that Reward Investment in Design (MADRID). Final Report. DIG Report 6; Design Innovation Group, The Open University.

For guidance on citations see [FAQs](#).

© [not recorded]



<https://creativecommons.org/licenses/by-nc-nd/4.0/>

Version: Version of Record

Link(s) to article on publisher's website:

<http://dx.doi.org/doi:10.21954/ou.ro.00015bcb>

Copyright and Moral Rights for the articles on this site are retained by the individual authors and/or other copyright owners. For more information on Open Research Online's [data policy](#) on reuse of materials please consult the policies page.



DESIGN
INNOVATION
GROUP

Design Council Co-Partnership Programme

Identifying Markets that Reward Investment in Design

**MARKET Demands that Reward
Investment in Design (MADRID)**
FINAL REPORT

Robin Roy, Johann c.k.h. Riedel & Stephen Potter

Submitted to The Design Council

DIG-06

January 1998 (Revised July 1998)

PROJECT IDENTIFICATION

Project Title

Identifying Markets that Reward Investment in Design.

The project has been given the acronym

MADRID (MARket Demands that Reward Investment in Design).

Project Leaders

Dr Robin Roy and Dr Stephen Potter.

Research Associates

Dr Johann Riedel (2.10.95 – 15.1.98)

Mark T. Smith (2 days/week 1.2.96 – 9.8.96).

Period

2 October 1995 – 30 September 1997

Address for Correspondence

The Design Innovation Group
 Department of Design and Innovation,
 Faculty of Technology,
 The Open University,
 Milton Keynes MK7 6AA
 United Kingdom.

Tel: +44 (0)1908 653970 **Fax:** +44 (0)1908 654052

Email: R.Roy@open.ac.uk S.Potter@open.ac.uk

Internet: <http://www-tec.open.ac.uk/design/>

ACKNOWLEDGEMENTS

This work was part of the Co-Partnership Programme of The Design Council, whose support is gratefully acknowledged. We are grateful to the Council's staff, especially Kate Burton, our Project Manager, and Jason Rabinowitz, Senior Research Manager, for their guidance.

We also wish to acknowledge the contributions of several other people to this project. In particular we wish to thank Mark T. Smith and Barry Dagger who helped greatly with the interviews and our academic assessors, Professor Susan Hart (Stirling University) and Dr Mark Oakley (Aston Business School) who, together with Dr Angela Dumas, Design Council Research Director, provided invaluable comments and advice as the project progressed. Other members of the OU/UMIST Design Innovation Group – Professor Margaret Bruce, Paul Gardiner and Dr Vivien Walsh – also provided valuable inputs.

We, of course, wish to thank all the busy individuals in the companies we visited for giving us their time and without whose co-operation the research could not have been undertaken.

Copyright © Design Innovation Group 1998

CONTENTS

Section 1: THE MADRID PROJECT

- 1.1 Project Aims
- 1.2 Relationship to Previous Work
- 1.3 Project Phases and Objectives
- 1.4 Obstacles Encountered in the Research
- 1.5 Contribution to the Design Council's Research Agenda
- 1.6 Dissemination of Results

Section 2: EXECUTIVE SUMMARY

Section 3: FULL REPORT OF RESEARCH ACTIVITIES AND RESULTS

BACKGROUND

NOTE TO THE READER

Phase 1: RE ANALYSIS OF THE CID DATABASE

3.1 Market Position and Commercial Performance

- 3.1.1 Methods for Mapping Market Position
- 3.1.2 Mapping of Commercial Performance
- 3.1.3 Conclusions of the Market Map Analysis

3.2 The Role of Design and Innovation

- 3.2.1 Design, Innovation and Competitiveness
- 3.2.2 Design/Innovation Role Analysis Method
- 3.2.3 Design and Innovation in Commercial Performance
- 3.2.4 Polar Profiles
- 3.2.5 Design Role and Market Strategy
- 3.2.6 Conclusions of the Design and Innovation Role Analysis

Phase 2: THE MADRID SURVEY

3.3 Survey Method

- 3.3.1 Sample Frame
- 3.3.2 Data Collection and Analysis

3.4 The MADRID Firms and Products

- 3.4.1 Company Survival
- 3.4.2 Firm Size
- 3.4.3 Industry Sector
- 3.4.4 What Happened to the CID Products?
- 3.4.5 The Selected Products
- 3.4.6 Design Resources of the Companies

3.5 Markets, Design Management and Company Success

- 3.5.1 Firm Growth and Market Type
- 3.5.2 Company Performance and Design Management
- 3.5.3 Conclusions of the Company-Level Analysis

3.6 Markets, Design and Product Success

- 3.6.1 Measuring Product Success
- 3.6.2 Product Success and the Product Market
- 3.6.3 Market Map Validation
- 3.6.4 Product Success and Design/Innovation Roles

3.7 Discussion and Conclusions

REFERENCES**APPENDIX: Future Research Priorities; Confidentiality**

Section 1

THE MADRID PROJECT

Aims and Outcomes

1.1 Project Aims

The MADRID project (MARket Demands that Reward Investment in Design) forms part of the Design Council's first Co-Partnership Programme on 'Design Effectiveness' and focuses upon the Council's research theme concerned with whether the returns on investment in design, and business attitudes to design investment, differ according to the market segments in which a firm is operating.

The main aims of the MADRID project were to identify:

- 1) which types of market(s) are most likely to produce the best commercial returns from investments in design and product development by UK firms;
- 2) the contribution of design and innovation to product competitiveness in different markets;
- 3) the long-term commercial and other benefits of investment in design and innovation.

1.2 Relationship to Previous Work

The MADRID project directly built upon the earlier Commercial Impacts of Design (CID) research project undertaken by the Design Innovation Group from 1987–90.

CID involved a survey of design and product development projects in 221 small and medium-sized firms. Most of these firms had received support under the Department of Trade and Industry/Design Council Support for Design programme and were sampled to be representative of UK manufacturing industry as a whole.

The CID study, for the first time, provided quantified information on the commercial returns upon investing in professional design expertise at the product level.

(For further details see Section 3 'Background' below.)

1.3 Project Phases and Objectives

The MADRID project was originally divided into three phases:

- Phase 1:** involved a re analysis of the data from the original CID study to provide information relevant to the first two of the above aims.
- Phase 2:** involved a longitudinal follow-up of a sample of CID firms to provide empirical evidence related to all three of the above aims.
- Phase 3:** involved a comparative study of competitor firms (including larger firms) operating in the same markets as the firms visited in Phase 2 which had not received any government support for design.

Following an external academic review on completion of Phase 1, it was decided to focus the empirical research of the MADRID project on conducting a longitudinal, follow-up survey of a sample of firms from the original CID study and not attempt to survey the comparative sample of competitor firms .

Not proceeding with Phase 3 enabled the number of firms from the CID database that could be revisited for in-depth interviews in Phase 2 to be increased from 20 to 42, thus providing a sample large enough to conduct valid statistical analyses. In addition the focus on design and product development in SMEs was retained. This focus seems justified given that over 99% of all UK businesses are SMEs with less than 500 employees (DTI, 1996).

Under the revised research plan, the Phase 1 objectives were retained, namely:

- to review and develop conceptual frameworks to enable data from the existing CID study to be re analysed;
- to use these frameworks in order to identify:
 - the types of market(s) most likely to produce the best commercial returns from investments in design and product development;
 - the contribution of design and innovation to successful product competition.

The Phase 2 objectives were modified, as follows:

- to provide empirical testing of results obtained in Phase 1 of the project;
- to identify long-term benefits of investments in design and new product development at both product and company levels;
- to explore relationships between company success and:
 - the nature of the market in which the business operates;
 - selected design management factors (e.g. management attitudes to design; employment of designers and engineers).

Since Phase 3 of the project was not pursued it was not possible to achieve the original objective of testing the general applicability of the results beyond the sample of SMEs that in the past had received government support for design. However, we are confident that the firms sampled in this project are typical of small and medium sized firms in UK manufacturing and hence the results should be of general relevance, at least to SMEs.

1.4 Obstacles Encountered in the Research

Access to companies and obtaining good financial information were clearly crucial and some difficulties were anticipated given the length of time that had elapsed since the CID study. In general these were satisfactorily overcome, but the following points should be noted:

a) The majority of companies contacted were willing to arrange an interview and were highly co-operative. However, most interviewees were busy and in a few cases this meant that it was not possible to obtain as much detailed information as would have been desirable. The few where company access was a problem was usually the result of recent changes in ownership or management.

b) It proved more difficult to obtain information on product sales, profit margins and other product-level quantitative financial data than in the earlier CID study. This was probably because CID was viewed by the companies as part of the Design Council's monitoring process for the Support for Design grant, whereas no such connection existed for MADRID.

We were able to obtain data sufficient to calculate product sales growth for half of the MADRID sample, but very few firms provided enough data to calculate the payback on investment, as had been possible for CID. The MADRID methodology enabled us to obtain qualitative measures of product commercial performance for the whole sample, which, although less reliable, we have used in addition to the available quantitative data.

c) A methodological problem emerged concerning interviewees being asked to rank certain variables (notably the contribution of different design factors to product success) on a 1–5 scale of importance. There was a tendency for interviewees to give most factors a relatively high importance ranking (probably because they were aware that most aspects of design *should* be considered in any project, even if this was not implemented in practice). In the analysis we compensated for this by only considering the highest ranks as representing a genuine priority, but the Phase 2 data on design and innovation roles is less clear-cut than we had hoped for in order to empirically test the Phase 1 analysis.

d) There was some development of the methodology and minor modification of the questionnaire following the first set of 5 interviews. In particular it became apparent that the most appropriate 'selected product' for in-depth investigation during the MADRID interview need not be the original

CID product, even if that product remained in production. Nevertheless the results of the first 5 interviews are valid and have therefore been included in the analysis.

1.5 Contribution to the Design Council's Research Agenda

The project provides empirical evidence relevant the Council's research theme on whether the returns on investment in design, and business attitudes to design, differ according to the market segments in which a firm is operating. The research also provides information on the long-term benefits of investments in design and product development.

The results of the research should thus contribute to Design Council's general aim of improving UK competitiveness through better use of design e.g. by helping to change attitudes of business and finance towards the value of sustained investment in design and product development; by providing tools that should help managers in UK firms to target their design resources at specific types of market to achieve commercial aims and to understand the different ways that design and innovation may be employed strategically to enhance product competitiveness.

1.6 Dissemination of Results

Publications to Date

Papers in Refereed Academic Journals

Roy, R. and Riedel, J. (1997b) Design and innovation in successful product competition, *Technovation*, Vol. 17 No. 10, October, pp. 537-548.

Roy, R., Riedel, J. and Potter, S. (1998) Firms and markets that profit from investment in design and product development, *The Design Journal*, Vol. 1, No. 2.

Chapters in Books

Roy, R. with Potter, S. and Riedel, J. (1998) The long-term benefits of investment in design and product development, in Jerrard, R (ed.) *Managing New Product Innovation*, Taylor and Francis.

Conference Papers

Roy, R., Potter, S. and Riedel, J. (1996) Investment in Design, in *Proceedings Design Council Research Workshop 1996*, London: The Design Council.

Riedel, J., Roy, R and Potter, S. (1996b) Investment in Design: A Market Analysis using the MADRID map, In *Proceedings 8th. International Forum on Design Management Research and Education*, Vol. 2, Boston: Design Management Institute.

Roy, R. and Riedel, J. (1996b) Design and Innovation in Successful Product Competition, In *Proceedings 8th. International Forum on Design Management Research and Education*, Vol. 2, Boston: Design Management Institute.

Roy, R. and Riedel, J. (1997a) The role of design and innovation in competitive product development, *Paper for Second European Academy of Design conference*, Stockholm, Sweden 23-25 April. (In Proceedings published electronically by Swedish Industrial Design Foundation at <http://www.svid.se>)

Roy, R. with Riedel, J. and Potter, S. (1997) The long-term benefits of investment in design and product development, In *Proceedings Design Council Research Workshop 1997*, London: The Design Council.

Working Papers

Riedel, J., Roy, R and Potter, S. (1996a) Mapping the Market – the MADRID Market Map, Working Paper WP-17, Design Innovation Group, The Open University, Milton Keynes, July, pp. 46.

Roy, R. and Riedel, J. (1996a) The Role of Design and Innovation in Product Competition, Working Paper WP-18, Design Innovation Group, The Open University, Milton Keynes, October, pp. 48.

Presentations

S. Potter and J. Riedel, Presentations to Design Council Staff Development workshop, December 1996.

Planned Publications

It is intended to prepare an extended report on this project for publication and press launch by the Open University in 1998 (as was done previously for the widely publicised report on the CID project).

Further papers will also be prepared for publication in several academic and professional journals, including *Journal of Product Innovation Management*, *European Journal of Marketing*, *Technovation* (second paper), *Design*, *Engineering Designer*, etc.

Other Dissemination

A number of key 'markets' exist for the results of this project. However, it is not the sole responsibility of the researchers to cover all these markets and it must fall to others to adapt our materials to these different audiences. Nevertheless, it is worthwhile identifying the markets that require addressing, including:

- Managers of design and new product development (especially in SMEs)
e.g. company directors; marketing managers; product managers; technical/design managers;
- Financiers of design and product development e.g. banks; venture capital lenders;
- Practising designers and engineers (in-house and consultants);
- Official bodies e.g. DTI; Design Council;
- Researchers and academics;
- Educators of designers, engineers and managers;
- Business advisors and consultants e.g. Business Links; management consultants; design consultants.

Section 2

EXECUTIVE SUMMARY of Main Research Results

Background

This report summaries the results of a study – entitled MADRID (MARket Demands that Reward Investment in Design) – which aimed to identify:

- whether and how the commercial returns from investments in design and product development vary with the types of market in which a firm operates;
- how design and innovation may be best employed to improve product competitiveness;
- what are the long-term benefits of investment in product design and innovation.

MADRID built upon an earlier research project on the Commercial Impacts of Design (CID). CID involved a survey of design and product development projects in 221 SMEs which had received a small government subsidy to employ a design consultant under a UK Support for Design programme.

Phase 1 of MADRID involved a re analysis of the data on selected projects from the original CID study. Phase 2 involved a longitudinal, follow-up survey (using semi- structured interviews) of a sample of 42 CID firms and product development projects, 8–9 years after the original study. The firms and projects for both Phases were sampled to be typical of small and medium-size UK manufacturers.

Phase 1 Main Findings

- 1) There were commercially successful products (measured in terms of payback on the total project investment) aimed at both price-sensitive and quality-oriented markets. Nevertheless, there were two noticeable clusters of successful products – aimed at mid-quality, niche markets and at mid-quality, volume markets.
- 2) In commercially successful product development projects, design had been used by companies either to move products ‘up-market’ into profitable, quality-oriented markets or, in the case of some high-quality niche market products, to reduce costs and thereby increase sales volume.
- 3) In the commercially successful projects more attention had been paid to genuine improvements in product performance, features and build quality than in the loss-making projects, which tended to focus on styling or cost reduction.
- 4) Commercially successful product development projects – and certainly the more technically complex ones – involved a broad, multi-dimensional approach to design with a focus on product performance, features and build quality and, where relevant, technical or design innovation. Loss-making projects tended to involve a narrow, often styling-oriented, approach to design, with more attention paid to the product range and costs than to performance, quality and innovation.

Phase 2 Product-Level Findings

The above findings were partially confirmed by the qualitative results of the Phase 2 empirical survey.

- 1) Products considered by the interviewees to be commercially successful tended to be competing in quality-oriented markets, while less successful products tended to be competing more often in price-sensitive markets. Moreover, the successful products tended to be those for which the company was either satisfied with its market position or planned to increase product quality.
- 2) Since the CID survey functional performance, build quality and purchase price remain, according to the interviewees’ ranking, the most important factors in product competition. However, since CID there is some evidence of price competition and prompt delivery becoming relatively more important.

This is consistent with general trends in competition since the late 1980s in which firms increasingly have to compete on price and service quality as well as on product quality and design.

3) Interviewees tended to rate most of the design/innovation roles (performance, styling, costs, etc.) as ‘important’ or ‘very important’ for their product. This indicates that SME managers and designers are now *aware* that most factors should be considered when designing a product but, given the considerable differences in the commercial performance of the products, it is likely that not all firms were equally *effective* in ensuring that these factors were actually taken into account. Unfortunately this also meant that the interviewees’ ratings were not sufficiently differentiated to confirm the above Phase 1 findings regarding the roles of design and innovation in the commercially successful and loss-making products.

Phase 2 Company-level Findings

Phase 2 of MADRID also produced a number of important company-level results, including the following:

1) The growing firms operated in growing markets and had typically developed innovative or niche products, while the declining firms generally operated in static or declining markets in which they had many competitors.

Thus, two-thirds of all firms whose turnover had grown in the past 5 years operated in growing markets, while over 80% of the firms whose turnover had declined operated in static or declining markets – these differences were statistically highly significant. In addition most of the fastest growing firms had developed products for which they had few competitors, either by offering a novel product or by operating in a specialist market niche, while, in all but one case, the declining firms were fighting against several competitors.

Moreover, on average the five highest performing firms in the less competitive/niche markets increased employment by 43% as well as displaying a 148% turnover growth in the last 5 years.

2) The fast-growing firms employed a higher proportion of RD&D staff; more often used external expertise for product development; and introduced new products more frequently, than the slow-growing or declining firms. These differences were statistically significant.

Thus, most (80%) of the fastest growing firms employed 5% or more of their total staff in RD&D. The slow growing and declining firms generally employed under 5% of RD&D staff and relied more on individuals, such as the Managing Director, to undertake product development as part of other tasks. Moreover, two-thirds of the growing firms had maintained or increased their employment of RD&D staff in the past 8–9 years, while 60% of static or declining firms had reduced their RD&D numbers.

Second, there was a striking relationship between turnover growth and the use of outside expertise for product development. All the fastest growing firms used external expertise (e.g. design consultants), whereas most of the slow-growing and declining firms did not. However, since the CID survey, the average proportion of design work undertaken externally had fallen from 18% to 11%.

Finally, two-thirds of the fast-growing firms introduced new products or ranges at least annually, while only a third of the slow-growing and declining firms did so. However, a surprising number (29%) of firms, including several of the fast-growers, were still making the products developed with assistance under the Support for Design programme, which had been first launched between 8 and 14 years ago.

3) There was a statistically highly significant relationship between management attitudes and company growth. All the growing firms had managers with a positive attitude towards investment in product design – and, where appropriate, technical innovation – and recognised their importance to the success of the firm now and in the future. By contrast the managers in the declining firms predominantly had a narrow and limited understanding of the contribution of design to the success of the firm.

Conclusions

These findings reinforce those of previous research that the relationship between investment in design and business performance is complex and interactive. In other words business success and investment in design and product development are likely to be mutually reinforcing, while poor financial performance and a failure to invest can lead to a cycle of decline. This study also supports the conclusions of other work that investing in design and product development is likely to be a necessary, but not sufficient, condition for good business performance.

Section 3

FULL REPORT

of Research Activities and Results

BACKGROUND

From 1987-90, the Design Innovation Group undertook a major study of design and product development projects in small and medium-sized UK manufacturers that had received some government design assistance. This 'Commercial Impacts of Design' (CID) study provided unique information on the commercial returns and indirect benefits upon investing in professional design expertise at the product level (**see Box**).

The CID study involved a survey of design and product development projects in 221 firms ranging in size from one-person businesses to firms employing up to 500 people, plus a few firms with 1,000 or more employees. Almost all of the firms had received support under the DTI/Design Council's Funded Consultancy/Support for Design programme to engage a design consultant for a limited period at zero cost or at a subsidised rate to help with the development of new or improved products, components, packaging, product graphics or technical literature. The firms were sampled to be representative of UK manufacturing industry as a whole (rather than of the FCS/SFD programme) and the projects embraced a wide range of products and technologies, from electronic instruments, industrial lasers and railway equipment, to textiles, furniture, domestic ceramics and food packaging. The CID database is a unique resource: comprising 91 completed face-to-face interview questionnaires and 130 postal questionnaires and computer and paper files of the survey data and its analysis. Quantified financial data (e.g. on project costs, product sales and profit margins) was obtained for 91 projects, while qualitative and/or quantitative commercial data was gathered for 178 projects. The database also contains information on the indirect benefits and learning effects arising from these projects. (Full details may be found in e.g. Potter et al, 1991; Roy and Potter, 1993; Bruce, Potter and Roy, 1995).

Since CID there have been several other studies which have attempted to measure the commercial benefits of investing in design and new product development in SMEs. These include a study by Groupe Bernard Julhiet (1995) which examined the extent that a sample of 500 French SMEs invested in industrial design and the costs and benefits of these investments at the firm level. Another study investigated the commercial performance of 38 products which had won a Dutch Good Industrial Design Award (Roerdinkholder, 1995). Both studies indicated that investing in industrial design confers commercial benefits for firms and for products. More recent research conducted by Gemser (1997a; 1997b) compared the business performance of matched samples from two sectors of 20 Dutch SMEs which routinely employed industrial designers with 20 which did not. She showed that furniture and medical/industrial instrument firms which regularly invested in industrial design performed better than those which did not, on a variety of business indicators. More generally a Design Council study, by Sentance and Clarke (1997), provided empirical evidence of a positive relationship between the level of design expenditure in different manufacturing industry sectors and their rate of output growth over ten years.

None of these studies, however, have addressed the question of whether investment in design for product development is dependent on the market in which the firm operates. Gemser's work provides some clues. In the furniture sector investment in industrial design was greater in firms making modern designs for up-market customers, whereas in instruments there was no relationship between the price/quality market segment aimed at and design investment.

The MADRID project takes as its starting point the Design Council's hypothesis that the returns on investing in design for product development depends on the nature of the market in which a company is operating (e.g. the degree to which the market is price or quality-oriented). In this study design is taken to mean the 'total design' of a product taking into account marketing, materials, performance, aesthetics, cost, manufacture, packaging and, where relevant, technical or design innovation.

Another issue neglected in previous research is the contribution that investing in design and innovation makes to product competitiveness. Gemser's study again provides some pointers. She showed that use of industrial designers had a number of positive effects on the development of furniture and medical/industrial instruments, including improved technical performance, more attractive appearance, increased ease of use, and the creation of innovative products. However, the precise roles of product design and innovation in improving competitiveness in different markets has not been studied before and is therefore the second major issue examined in this project.

The final major area examined in this study concerns the long-term benefits of investing in product design and innovation. Access to firms from the earlier CID survey enabled us to explore questions such as: did firms that had successful projects increase their use of professional design expertise and build design and innovation into their company strategy? And did the firms with the less successful projects learn from the experience and manage product development more effectively in subsequent projects?

NOTE TO THE READER

In order to address the above issues, the MADRID project has been divided into two main Phases.

For completeness the Report starts with a summary of Phase 1 of the project, covering previously published material on the re analysis of data from the CID study.

If you are familiar with the Phase 1 findings, it is possible to start at Section 3.3 with the methods and results of Phase 2 – the longitudinal follow-up survey – which are published here for the first time.

Phase 1:

RE ANALYSIS OF THE CID DATABASE

Phase 1 involved a re analysis of existing data from the CID survey to identify:

- the types of market(s) most likely to produce the best commercial returns from investments in design and product development (**discussed in Section 3.1 below**);
- the contribution of design and innovation to successful product competition (**discussed in Section 3.2 below**).

3.1 Market Position and Commercial Performance

The methods and results summarised in this section are fully documented in working paper WP-17 by Riedel, Roy and Potter, S. (1996a) previously submitted to the Design Council. More details may also be found in a conference paper by Riedel, Roy and Potter, S. (1996b).

In order to explore whether the benefits of investing in design depends on the market at which the resultant product is aimed, it was necessary first to find a suitable conceptual framework with which to re analyse the product-level data from the existing CID survey. Various approaches were considered (including those in the corporate strategy, strategic marketing and the price/quality competition literature e.g. Porter, 1980; Buzzell and Gale, 1987; Jacoby and Olsen, 1985). It was decided that the most appropriate approach would be some form of ‘market map’ on which products from the CID study could be positioned. This would display one or more key market variables and enable the position (and movements in position resulting from design changes) of CID products of different degrees of commercial success to be mapped.

3.1.1 Methods for Mapping Market Position

Several techniques for mapping the market (e.g. in terms of growth rate, market share, competitive intensity, price-sensitivity, etc.) were identified from a literature search – including the Boston Consultancy Group’s product portfolio map and the directional policy matrix (Brown, 1993), perceptual market maps (Croft, 1994), the price/non-price factors map (Gardiner, 1995) and price/quality maps (Buzzell and Gale, 1987).

This review indicated that an existing market mapping scheme could not be adopted ‘ready made’ and applied to the data from the CID study. Therefore, a framework needed to be derived from those in the literature and modified for the needs of this research project. A new method for mapping the sensitivity of the market to both price and product quality at individual product level, but which could also indicate strategic market moves, was needed. It would also be useful to include quantity of product sold on the map because, although it is often assumed that price-sensitive markets are high volume ones, some niche markets can also be highly price-sensitive.

The MADRID market map (Figure 3.1.1) has two dimensions. The vertical axis measures the degree to which a market is sensitive to the price and quality of a product. The horizontal axis measures volume, the extent to which a product is aimed at a mass market or a niche market. The two dimensions of the market map allow the mapping of market segments within which products are placed.

In positioning products or projects on the vertical axis the criterion is whether companies sell their product mainly on price or on quality. ‘Quality’ represents a bundle of attributes, such as performance, style, reliability, materials, finish, ease of use, etc. appropriate to the particular product. A map position thus represents the relative importance of price and quality for an individual product in its market segment.

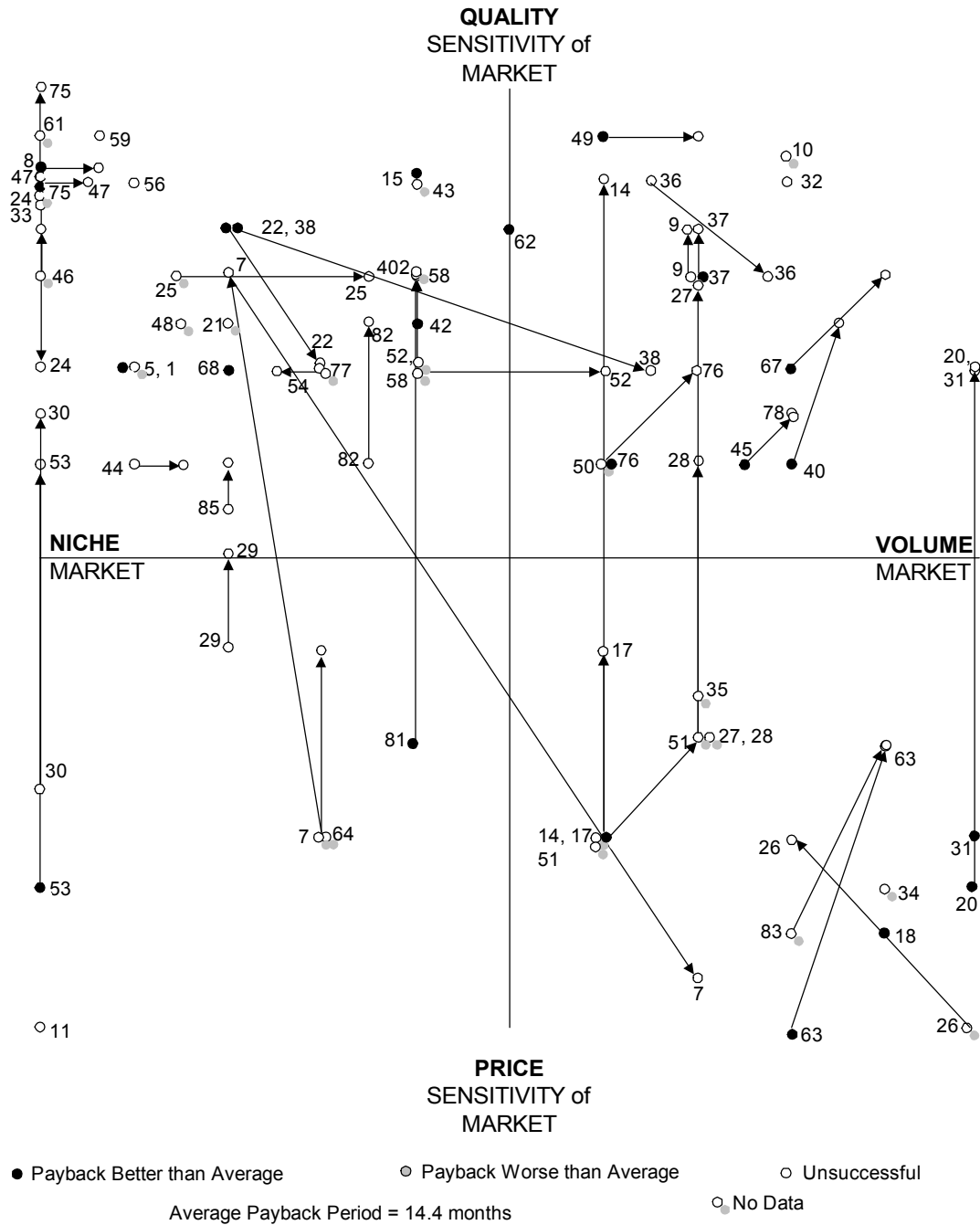


Figure 3.1.1 MADRID market map showing positions and market moves of products before and after the Support for Design project. Projects with above and below average payback periods are also indicated

The horizontal dimension measures the size of the market at which a product is aimed. Thus volume products are assumed to always sell more units than niche products. So a score of - 5 on the ‘niche’ side of the volume axis is a low volume product within its niche market (e.g. a bus shelter), whereas near zero is a high volume product in its niche market (e.g. a budget hi-fi amplifier). The right-hand side of the volume axis indicates the size of the market that the product is operating in, thus high scores are given to mass-produced items, e.g. vehicle components.

It should be emphasised that the MADRID market map was developed for the particular purpose of re analysing the CID data and is **not** proposed as a contribution to marketing or economic theory. Moreover we recognise that, increasingly, companies are competing in markets in which *both* high

quality and low prices are demanded, which is not easy to plot on the MADRID map. In such situations an alternative map of Quality v Price was employed.

3.1.2 Mapping of Commercial Performance

In total 64 products from the face-to-face interview section of the CID database were positioned on various MADRID maps. In interpreting the maps it is important to remember that the position of a product on the MADRID market map was based on a qualitative judgement and not on any new information obtained from the firms. The positions were derived from a group discussion by research team members using information in the CID database – in particular the interview summaries, the original face-to-face questionnaires and product brochures of the company.

Further information was placed on the map as well as the project/product's market position. Each product is identified by an ID number. A filled-in circle represents the position of a product prior to the Support for Design project. Some products, as a result of the SFD project, moved in the market – this is represented by a line with an arrow indicating the direction of movement (with an open circle indicating the end-point of the move). Products which did not move are indicated by single filled-in circles.

The map can be used to explore patterns of market position and moves using the measures of commercial success used in the CID project. Figure 3.1.1, for example, shows the positions, and movements in position, of those products for which we had information on the project payback period.

Key findings of the commercial performance analysis were:

- Most companies were attempting to move 'up-market' via their design projects. Even those companies that already made high-quality products were moving up-market through investment in design expertise.
- The exceptions were companies which made high-quality but relatively low volume products. These were generally attempting to increase sales volume and thus had to lower their prices, for example by using design for cost-reduction.
- Generally companies in the sample were using design to move their products toward the Quality–Volume (QV) quadrant, with none moving out of it. This quadrant is a commercially very good one to be in, as companies can charge premium prices for high product quality whilst selling in volume.
- There were two areas for commercial success – in which a significant number of commercially above average performing products were located (or had moved into) – mid–Quality–Volume (QV) and mid–Quality–Niche (QN) markets.
- There were examples of successful projects in the Price-sensitive–Volume market (PV – bottom right). Again the firms concerned wished to gain a competitive edge through adding value/ quality while reducing the price-sensitivity of their products through the use of design.
- The Price-sensitive–Niche market quadrant (PN – bottom left) can be a problematic quadrant. It appears difficult to succeed commercially in it and very difficult to get out of it. Only one company succeeded in doing so.

3.1.3 Conclusions of the Market Map Analysis

The analysis of the market maps showed that at the time of the CID interviews, companies were attempting to use design to move their products up-market and/or to increase their sales within their existing quadrant. None were moving down market (bar the exceptions of high product quality companies trying to capture larger sales volumes).

The analysis of commercial performance maps showed that there are commercially successful products in all four market quadrants. There were two particular areas for commercial success – mid-

quality niche markets and mid-quality volume markets. Companies aiming products at the price-sensitive volume market were also successful.

The observations regarding the type of data required to effectively analyse market position and movement were fed into the development of the questionnaire used in Phase 2 of the research. However, before reporting this, Section 3.2 documents the second major task of this study's Phase 1, which was to analyse the role of design and innovation in product competition.

3.2 The Role of Design and Innovation in Product Competition

The methods and results summarised in this section are fully documented in working paper WP-18 by Roy and Riedel (1996a) previously submitted to the Design Council. More details may also be found in a journal article by Roy and Riedel (1977).

3.2.1 Design, Innovation and Competitiveness

Numerous studies have identified the crucial role that product design and technical innovation play in improving competitiveness (see e.g. Wray, 1991; Utterback, 1994). But, despite a general agreement on their importance, the precise roles of design and innovation in improving the competitiveness of a company's products remains a complex issue.

The approach adopted in this study to this issue arose from previous work on price and non-price competition (e.g. Rothwell and Gardiner, 1984; Buzzell and Gale, 1987; Walsh et al., 1992). This work showed that product design and innovation could affect both *price* competition, through design for economic manufacture and low life-cycle costs, and *non-price* competition, through:

- (a) the technical design of the product to improve performance, appearance, quality, etc.:
- (b) the application of new technologies to create a novel product;
- (c) by taking into account associated service-related non-price factors such as product advertising, packaging and display and designing for ease of servicing and repair.

3.2.2 Design/Innovation Role Analysis Method

To gain a fuller understanding of how design and innovation might affect competition, a case analysis was undertaken of the camera market. Cameras are relatively complex products which embody a wide range of technical and design elements that are constantly being changed.

The camera case study provided a generic list of ways that design and technology could be used to differentiate and enhance the competitiveness of a product – including performance, features, styling, build quality, costs and incremental or radical innovation (see Tables 3.2.1 and 3.2.2).

In conjunction with this list, a 'polar profile' map was developed, to display these multiple dimensions in graphical form. This polar map shows seven dimensions through which the competitiveness of a product may be enhanced – six concerned with Design and one with Innovation (labelled 'Technology') – see Figure 3.2.1. Each dimension on the polar map has two elements so as to include most of the categories in the generic list of design/innovation roles. For example, the 'Style' dimension has two elements representing the styling of the product itself and styling of the product packaging.

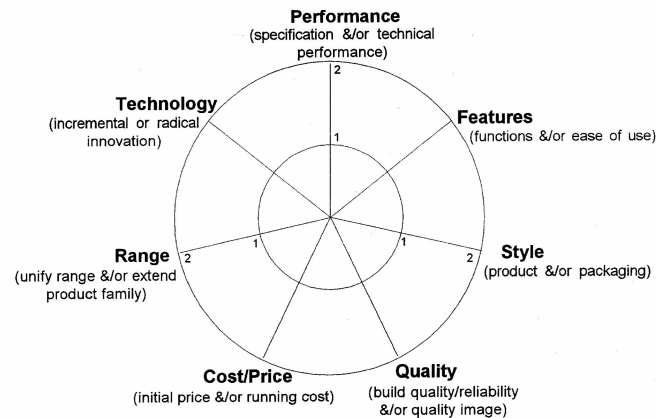


Figure 3.2.1 The Design/Innovation Polar Profile Map.

Each 'dimension' on the map (Performance, Features, etc.) represents a broad approach to improving the competitiveness of a designed product, and each dimension is broken down into two elements (given in brackets) representing more specific ways of enhancing product competitiveness.

3.2.3 Design and Innovation in Commercial Performance

For the purposes of the MADRID study, the lists of design/innovation roles were employed to analyse how design and innovation had been utilised in commercially successful and loss-making product development projects from the existing CID survey database. The analysis also aimed to discover if different polar profile maps emerged according to the type of project.

A total sample of 44 products/projects from the CID database were selected for analysis. This included 32 successful projects which were divided into quartiles according to their commercial performance as measured by the payback period on the total investment. Twelve projects which made a financial loss were also identified as suitable for analysis.

Design Roles

The analysis of the role(s) that design played in each project was based on an examination and 'consensus' discussion by research team members of the information in the CID database (similar to the method employed for the market mapping discussed in Section 3.1.2). The results of this analysis are shown in Table 3.2.1.

Table 3.2.1 Design roles in commercially successful product development projects

	COMMERCIAL	PERFORMANCE
DESIGN ROLE	Upper 2 quartiles (payback period) (16 projects) <i>Frequency</i>	Lower 2 quartiles (payback period) (16 projects) <i>Frequency</i>
Performance <i>Improve specification/ technical performance</i>	5	5
Features <i>Provide new/ improved features</i>	17	13
- improved function	9	6
- improved ergonomics /ease of use/safety	8	7
Style <i>Improve style/ image/provide the 'X' factor/'Wow'</i>	16	14
- the product itself	14	10
- product packaging and display	2	4
Quality <i>Improve build quality/reliability/durability</i>	9	9
	3	4
<i>Convey impression of quality</i>	6	5
Cost/Price <i>Reduce manufacturing, distribution, etc. costs</i>	7	8
	2	1
- Reduce sales price	3	4
- Increase profit margin	2	3
Range	13	11
Unify product range	2	2
Extend range/product family	11	9
Reduce running costs - energy, consumables, etc. - servicing, repair, replacement	0	0
Compliance with standards/ regulations (including environmental)	1	1
Customisation/ special purpose	0	4
Other	5	2

Total sample: 32 projects

The numbers in **bold** are total occurrences for each design role, for the 16 successful projects present in each of the upper two and lower two payback quartiles.

To highlight any differences in design role and commercial performance, a summary chart comparing the relative frequency of the main design roles or 'dimensions' in the profitable and the loss-making projects was compiled using the frequency data from the detailed tables (Figure 3.2.2).

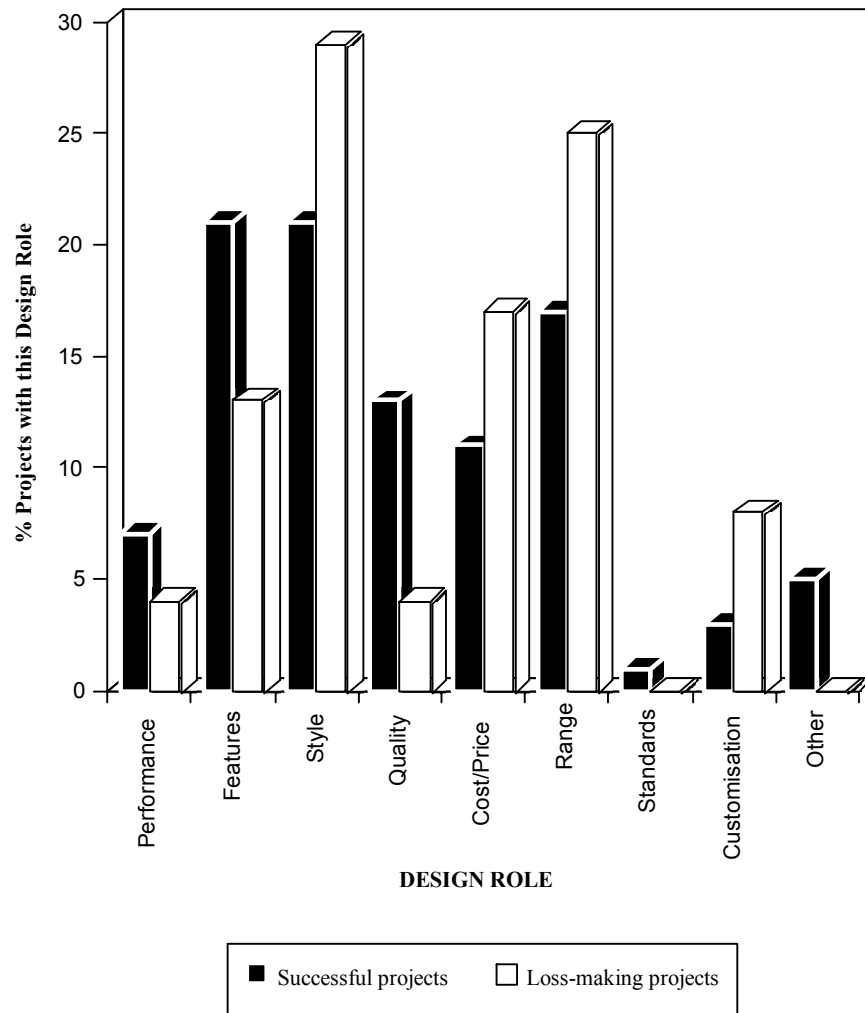


Figure 3.2.2 Comparison of design roles for commercially successful and loss-making projects

Innovation Roles

Only some 20% of the projects were considered to have involved any kind of innovation. The innovations ranged from a supermarket cheque-writing machine to a patented device for joining wire. In Table 3.2.2 these are divided into 'incremental' and 'radical' innovations. Due to the small numbers involved, it is hard to draw firm conclusions.

Table 3.2.2 Innovation roles in commercially successful and loss-making product development projects

	COMMERCIAL	PERFORMANCE
INNOVATION ROLE	Successful (32 projects) <i>Frequency</i>	Loss-making (12 projects) <i>Frequency</i>
Incremental	5	1
Radical	2	1

Total sample: 44 projects

3.2.4 Polar Profiles

The above analysis is based on aggregated information from a variety of products, ranging from electronic equipment to textiles. In order to see if there were differences for different types of product, the information in the design and innovation role tabulations was employed to plot a polar profile map, similar to that in Figure 3.2.1, for each of the 44 selected products.

In profiling a particular product, if one element of a given design or innovation dimension was considered to be present in the project it was plotted on the inner ring of the map (i.e. in position '1'). If both elements seemed to be involved it was plotted on the outer ring (i.e. as '2'). (The exception was the 'Technology' dimension, in which a radical innovation scored 2 while an incremental innovation scored 1.)

The profiling process thus gave the roles of design and/or innovation for the 32 commercially successful products grouped into payback quartiles. Figure 3.2.3 shows the polar profile maps for two of the eight projects which paid back their total investment most rapidly. Polar profiles were also produced for the 12 commercially failed projects.

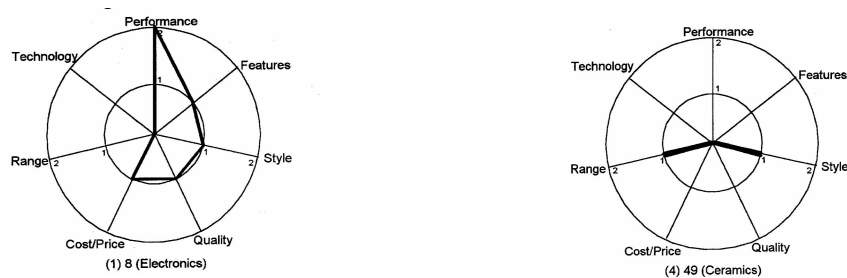


Figure 3.2.3 Polar Profile Maps for two commercially successful products.

Left: Payback rank (1) project no. 8 for an Electronics product.

Right: Payback rank (4) project no. 49 for an Ceramics product.

3.2.5 Design Role and Market Strategy

To understand whether particular market strategies were associated with particular design roles a further analysis was conducted. This analysis took a sub-sample of 24 products/projects, which in the market mapping exercise (Section 3.1.2) had been classified as having involved one of four strategic market moves in their development:

- 1) a move up-market to a more quality-sensitive market;
- 2) a move to a more price-sensitive market in order to capture increased sales volume;
- 3) an attempt to increase sales volume by maintaining the overall quality attributes of the product but without reducing the price;
- 4) a move down-market to a more price-sensitive market.

This analysis showed that the most common market move, accounting for two-thirds of the projects, involved an attempt to shift the product into a more quality-sensitive market. In making this move up-market, design was used in various ways, most often in improving its functional and/or ergonomic features and in improving the styling of the product or its packaging.

3.2.6 Conclusions of the Design and Innovation Role Analysis

A number of observations from the design role analysis and polar profile maps can be made:

- In commercially successful product development projects more attention had been paid to genuine improvements in product performance, features and quality than in the loss-making projects, which tended to focus on styling or cost reduction.
- There were clearly different patterns in the design and innovation roles for different types of commercially successful project. For example, successful electronic design projects appear to involve consideration of multiple dimensions of design and innovation, while a successful ceramics design project may require consideration of only two or three design dimensions.
- Commercially successful product development projects – and certainly the more technically complex ones – involved a broad, multi-dimensional approach to design with a focus on product performance, features and build quality and, where relevant, technical or design innovation. Loss-making projects tended to involve a narrow, often styling-oriented, approach to design, with more attention paid to the product range and costs than to performance, quality and innovation.
- Commercially successful projects tended to use design strategically either to move up-market, by creating genuine improvements in product features, or to increase sales of an already high-quality product by reducing its price while simultaneously improving product performance, and features. Styling the product and/or its packaging is an important element of these successful strategies, but apart from relatively simple products, is unlikely to be sufficient on its own to result in commercial success.

Phase 2:

THE MADRID SURVEY

As was explained in Section 1.3, Phase 2 of MADRID involved a longitudinal follow-up survey of a sample of 42 firms and products from the original CID study, with two main objectives:

- to provide empirical testing of results obtained in Phase 1 of the project;
- to identify long-term benefits of investments in design and new product development at both product and company levels.

3.3 Survey Method

3.3.1 Sample Frame

We chose firms from the CID database which had conducted product, engineering or engineering/industrial design projects. Pure graphics and packaging design projects were excluded. Care was taken to sample firms which experienced commercially successful and ‘failed’ projects, the latter including non-implemented projects and those which had been put into production but made a loss. This meant contacting firms from both the face-to-face and postal sub-samples of CID, as most of the ‘failed’ projects had been surveyed by postal questionnaire.

Before a visit was arranged a short telephone interview was carried out to establish the status and suitability of the firm and to identify a ‘selected product’ to be the focus of the face-to-face interview. Where possible we selected the original product surveyed at the time of CID. But if that original product was not in current production, or had become peripheral to the firm’s business, we identified a suitable successor product or range. In either case a pro-forma requesting financial information for the ‘selected product or range’ was sent to the firm before the interview.

3.3.2 Data Collection and Analysis

A semi-structured questionnaire was designed, using the previous CID questionnaire as a starting point together with the concepts developed during Phase 1 of MADRID. This questionnaire was administered in company interviews with senior managers, marketing or technical staff, lasting approximately 2–3 hours, in order to provide information:

- (a) at *firm* level on ownership, size, turnover, the product range, the firm’s markets, employment of research, design and development staff, management attitudes towards design and innovation, etc.
- (b) at *product* level focusing on the ‘selected product or range’ – financial performance; price and quality factors in positioning the product in the market; the role of design and innovation in improving its competitiveness, etc.

The questionnaire was piloted in three firms. This led to some modifications, followed by further minor changes during the first batch of interviews.

Out of 75 firms initially contacted, 9 firms had ceased trading or were untraceable, 15 were unsuitable or unwilling to take part and another 8 were not pursued to an interview. Interviews were thus obtained with 43 firms. In a few cases full information was not obtained. In one case only was the information so sparse that the results were not entered on the MADRID database.

An analysis framework was established to allow comparison of the data obtained in the MADRID interviews with some of that from the original CID survey. Variables were entered onto a database, either direct from the questionnaires or after coding. This data was subjected to computer-based analysis using SPSS and Excel, combined with manual analysis when required or more convenient.

Sections 3.4 – 3.6 below summarise the main results of this analysis to date.

3.4 The MADRID Firms and Products

3.4.1 Company Survival

Very few of the 75 firms initially contacted had gone out of business since the original CID survey of 1988–89. Only four firms had definitely ceased trading. A further 5 firms were untraceable, which could either mean they had closed or had merely changed name. Thus a maximum of some 20% of the firms have gone out of business, which is a good record for SMEs, especially given the severe UK recession of the early 1990s.

3.4.2 Firm Size

The majority of firms surveyed were SMEs with below 500 employees (Table 3.4.1). Since the CID interviews, the number of people employed by the firms had generally declined, although (as will be noted later) turnover had generally increased. An exception was that the very small firms at the time of CID had grown in employment.

Table 3.4.1 Size of firms

EMPLOYEES	MADRID Firms		At CID Visit	
	Number	Percentage	Number	Percentage
<10	1	2.4%	4	10.5%
10-99	21	51.2%	15	39.5%
100-499	15	36.6%	16	42.1%
500+	4	9.8%	3	7.9%
TOTAL (n)	41*	100%	38†	100%

* 1 not known † 4 not known

3.4.3 Industry Sector

The original CID sample was carefully chosen to include firms in sectors representative of UK manufacturing industry as a whole and this approach has been carried forward in the sampling of firms for this follow-up study.

The sector of the 'selected products' was chosen to coincide with that of the firm as a whole, and ranged from textiles and furniture to electronic equipment and motor vehicle components (Table 3.4.2.)

Table 3.4.2 Sector breakdown of selected products/firms

SECTOR (SIC 1992)	Number	Percentage
Textiles and textile products	4	9.5%
Rubber and plastic products	2	4.8%
Non-metal mineral products (e.g. ceramics, glass)	4	9.5%
Fabricated metal products (e.g. cutlery, general mech. engineering)	7	16.7%
Machinery and equipment (e.g. machine tools, domestic appliances)	6	14.3%
Electrical and optical equipment (e.g. computers, electrical machinery, audio equipment, instruments)	11	26.2%
Transport equipment (e.g. motor vehicles and parts)	4	9.5%
Other manufacturing (e.g. furniture, sports goods)	4	9.5%
TOTAL (n)	42	100%

3.4.4 What Happened to the CID Products?

The MADRID interviews sought to discover what happened to the original product/range surveyed at the time of CID (Table 3.4.3).

Table 3.4.3 Outcomes of the original supported design projects

OUTCOME	Number	Percentage
Still in production (with only minor modifications)	12	28.6%
Substantially modified/redesigned	6	14.3%
Replaced by a new product or range	15	35.7%
Only produced to special order	4	9.5%
Other developments	5	11.9%
TOTAL (n)	42	100%

A surprising number (29%) of firms were still making the products developed with assistance under the Support for Design programme, and which had been first launched between 8 and 14 years ago. Although this apparent lack of new product development can be regarded as negative, in several cases this was not so. For example, the manufacturer of an innovative front-opening bath had built up a substantial niche market around a design which needed little further development. In another case the original product, a range of hospital furniture (Figure 3.4.1), has not altered in design, but its manufacture had been automated. At the same time new product ranges were introduced.

14% of firms still made the original product but had substantially modified or redesigned it technically and/or aesthetically. For example, an innovative wire joining device (Figure 3.4.2), proved to be an excellent core design which remained in production while variants for new markets were developed.

Over a third had replaced the original product with a new product or range of products in response to market and/or technical change (e.g. Figure 3.4.3). In many cases this formed part of an expansion of the company's product portfolio.



Figure 3.4.1 The Crendon range of wooden hospital furniture, originally developed with assistance from Support for Design, has remained in production since its launch in 1987, but the manufacture of its components has been automated. (With permission from Teal Furniture Ltd.)



Figure 3.4.3 The Alpha 5+ hi-fi amplifier, launched in 1995, is one of a series of new and improved designs that have evolved from the original Arcam Alpha of 1984 developed with assistance under Support for Design. The latest model is the Alpha 7. (Photo: Richard Hearne, Open University.)

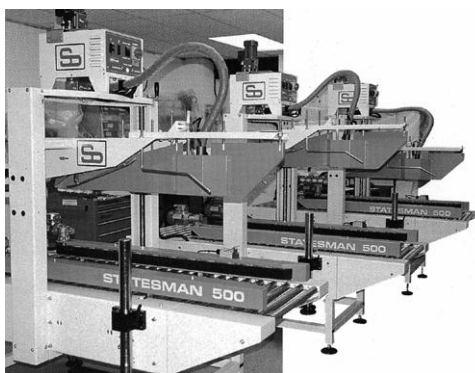


Figure 3.4.4 Statesman cardboard case gluing and taping machine, first introduced in 1987, remains in production to special order although the firm now concentrates on more recent types of packaging machine. (With permission from System Devpak Ltd.)

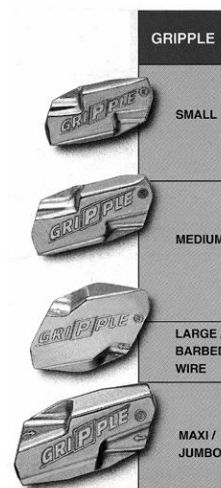


Figure 3.4.2 The Gripple patented wire joining device, the original design of which was created with assistance from Support for Design, has been significantly improved since its introduction in 1988. The design has been developed into a range of sizes for different applications, for example vine supports. It has also formed the basis of new products for new applications such as a wire rope grip. (With permission from Gripple Ltd.)



Figure 3.4.5 Twinlock Personal File launched in 1994 as a new product. The original product, a computer printout binder, remains in production. (Photo: Richard Hearne, Open University.)

Some original CID products remained available to special order even though a successor product had been developed. This occurred where commercial/industrial customers still had examples of the original product in use and wanted the same design when replacements were needed (e.g. Figure 3.4.4).

3.4.5 The Selected Products

As noted above, if the original CID product was no longer in production, its direct successor was selected to be the focus of the interview. In some cases there was an overlap between the CID product and its successor(s). Generally when this occurred, the successor product was chosen (e.g. Figure 3.4.5), as the original product was only produced in small quantities. In a few cases, when there was no successor product, another product was selected on the basis of a discussion with the firm to identify a product which linked to developments in its markets.

Overall 38% of the selected products were the same as the original CID product, 5% were modified versions of the original product and 57% were new products or ranges.

The types of design expertise used to develop the selected products was diverse. 33% were developed using product design expertise, 26% using engineering design skills and just over 40% using a mix of engineering and industrial design skills.

31% were consumer products; 40% were commercial/contract goods; and 29% were industrial products or components.

3.4.6 Design Resources of the Companies

In most (nearly 60%) firms, the proportion of staff for whom Research, Design and Development was their main job was less than 5% of all employees. However, there was a strong cluster of firms (27%) where 10% or more of staff are in RD&D (Table 3.4.4).

In general there was a similar number of other staff (e.g. managers, marketers), some of whom had RD&D qualifications, who undertook some RD&D as part of another job.

Where a comparison is possible with the CID data, 12 (33%) of companies increased their proportion of RD&D staff, in 6 (16.7%) it was unchanged and in 18 (50%) it had declined.

**Table 3.4.4 Full-time RD&D staff
as a percentage of all employees**

% FULL-TIME RD&D STAFF	MADRID Firms		At CID Visit	
	Number	Percentage	Number	Percentage
0%	10	24.4%	6	16.6%
< 2%	6	14.6%	2	5.6%
2 < 5%	8	19.5%	12	33.3%
5 < 10%	6	14.6%	9	25.0%
10 < 20%	10	24.4%	5	13.8%
> 20%	1	2.4%	2	5.6%
TOTAL (n)	41	100%	36	100%

As well as internal RD&D staff, external design expertise was used by two-thirds of the firms, with a only third doing all their RD&D work in-house (Table 3.4.5). For most companies, external expertise (design consultants, universities, test labs, etc.) undertook 20% or less of the design work.

In general, since the CID project, the proportion of design work undertaken externally has dropped from an average of 18% to an average of 11%.

Table 3.4.5 Proportion of RD&D undertaken in-house

PERCENTAGE IN-HOUSE RD&D	MADRID Firms		At CID Visit	
	Number	Percentage	Number	Percentage
≤ 10%	1	2.6%	1	3.8%
11–49%	0	0%	1	3.8%
50–89%	10	25.6%	6	23.1%
90–99%	15	38.5%	9	34.6%
100%	13	33.3%	9	34.6%
TOTAL (n)	39	100%	26	100%

3.5 Markets, Design Management and Company Success

In this section we attempt to identify relationships between the performance of the MADRID firms, the nature of the markets in which they operate and their management of design and product development.

3.5.1 Firm Growth and Market Type

A number of measures of firm performance were used in MADRID, but the most satisfactory was considered to be turnover growth over the past 5 years. This is a similar performance criterion to that adopted by Hart and Service (1988), Service, Hart and Baker (1989) and Sentance and Clarke (1997) in their studies of design management and firm success.

Information on sales turnover was obtained from 39 of the 42 companies surveyed. Significant break-points were identified that divided the sample into quartiles, as follows:

Quartile	Performance Category	Turnover growth over past 5 years	Number of firms
1st	Very fast-growing	> 85%	10
2nd	Fast-growing	33 – 77%	10
3rd	Moderately growing	11 – 29%	9
4th	Static or declining	0% to 59% decline	10

This categorisation has been used for the subsequent analyses in this report.

However, a number of studies show that firm growth has to be considered in the context of the type of market in which the firm is competing. For example, Porter (1980), Buzzell and Gale (1987) and Kotler (1988) show that the ability of a firm to grow is related, among other things, to whether the market for a firm's products is growing, how many competitors the firm has in that market (competitive intensity), and the maturity of the products involved.

Thus, the types of market in which our sample firms were attempting to survive and grow range from 'very difficult' static or declining markets for mature products fought over by many competitors, to relatively 'easier' growing markets with few competitors.

Classifying the firms by turnover growth did indicate a relationship with the growth and competitive intensity of the market in which the firms operated (see Table 3.5.1).

Table 3.5.1 Company Growth and Market Type

NATURE OF MARKET	Market Static or Declining in past 5 years	Market Growing in past 5 years
Competitive market	<p>1065 FLOWMETER 1025 TORQUE WRENCHES</p> <p>1053 Bus shelter 1073 Lorry trailer 1242 Hi-fi loudspeaker</p> <p>1230 Water standpipe 1032 Bicycle lock 1040 Kitchenware 1054 Bar stool 1064 Car park barriers</p> <p><i>1010 Luggage</i> <i>1255 Cockpit light dimmer</i> <i>1072 Car sunroofs</i> <i>1085 Shoe repair equipment</i> <i>1050 Lorry cab</i> <i>1278 Analogue panel meters</i> <i>1043 Mirror panelling</i> <i>1030 Street furniture</i> <i>1332 Outdoor clothing</i></p>	<p>1044 FUND TRANSFER TERMINALS 1038 HI-FI EQUIPMENT 1293 ROPE HOLDING SYSTEMS</p> <p>1306 Contract furniture 1083 Car seat adjuster 1058 Food cabinet 1312 Wet/dry vacuum cleaner 1011 Rail switches/crossings 1029 Temperature controller 1080 Packaging equipment</p> <p>1238 Anaesthetic machine 1223 Litho plate processors 1037 Ceramic tableware 1224 Personal filing cabinet</p> <p><i>1256 Desk modules</i></p>
Less competitive market	<p><i>1047 Packaging machinery (niche)</i></p>	<p>1063 WIRE JOINING DEVICE (novel) 1005 TEXTILES (niche) 1061 BATH (novel) 1281 PEDESTRIAN BARRIERS (niche) 1077 WIND TURBINE (niche)</p> <p><i>1217 Valve tester (niche)</i></p>

n=41

Key: **1044 = VERY FAST-GROWING FIRMS**

1281 = Fast-growing firms

1025 = Moderately-growing firms

1030 = Static/Declining firms

Note: Firms are identified by code number/selected product and are listed within each box in rank order of turnover growth. Two additional declining firms (1030, 1032) have been added to this matrix for which the exact decline is not known. (Where the selected product is novel or competes in a specialist market niche, this is noted in brackets.)

Table 3.5.1 shows that there are rapidly growing firms in each of the four market categories. However, 80% of the very fast-growing firms, and 66% of all growing firms, operated in growing markets and only 20% and 33% respectively were in static/declining markets. In addition half of the very fastest growing firms had developed products for which they had few competitors, either by virtue of offering a novel product or by operating in a specialist market niche.

By contrast over 83% of the declining firms operated in static or declining markets and in all but two cases they were fighting against several competitors. The relationship between firm growth and market growth was highly statistically significant (Chi-Square $p < 0.003$). However, the sub-sample was too small to show a statistical relationship between firm growth and competitive intensity.

It is notable that the nature of the market and the type of products made affected whether the firms had grown in turnover alone or in both size *and* turnover. One firm that was competing in a very difficult competitive and static market for industrial hand tools had managed to grow fairly fast by reducing its work force by 42% over the past 5 years. This increased productivity, coupled with a range of new and improved designs, enabled it to increase its turnover by 125% over the past 5 years and 67% since CID.

The very fast-growing firms operating in less difficult markets managed to grow substantially both in number of employees and turnover. On average the 5 highest performing firms in the less competitive/niche markets increased employment by 43% as well as displaying a 148% turnover growth in the last 5 years.

Market sectors

The above results might of course be affected by differences in company growth rates in different market sectors. Growth rates were therefore examined against the broad market sector aimed at and also against the SIC of the firms (as set out earlier in Table 3.4.2).

Fast-growing firms were found in all market sectors – consumer, commercial and industrial. But apart from a higher proportion of static and declining firms operating in commercial and industrial markets, there appeared to be no statistical relationship between firm growth and its market sector or SIC, which is, perhaps, surprising.

3.5.2 Company Performance and Design Management

Employment of RD&D Staff

The human resources that the companies devoted to Research, Design and Development were outlined in Section 3.4.6. We examined whether this had any effect on company turnover growth.

Table 3.5.2 Company growth and employment of RD&D staff

Full-time RD&D staff as % all employees	Very fast growing firms	Fast-growing firms	Moderately growing firms	Static and declining firms*
0 < 5%	2 (20%)	5 (50%)	7 (77.8%)	5 (55.6%)
5 – 20% +	8 (80%)	5 (50%)	2 (22.2%)	4 (44.4%)
TOTAL	10 (100%)	10 (100%)	9 (100%)	9 (100%)

* 1 N/A

Table 3.5.2 suggests that there is a positive link between firm growth and the proportion of full-time RD&D staff employed – indeed, if the very fast/fast growing firms are compared to the moderate growers/static and declining firms, the relationship is statistically significant (Chi-Square $p = 0.05$). Although not shown in the table, the slower growing firms relied more on individuals doing RD&D as part of other tasks. Commonly this was the Managing Director, sometimes with assistance from people like the works manager or shop floor employees.

The change in the number of RD&D staff since the CID interviews supports the relationship of RD&D employment with turnover growth (Table 3.5.3). In the past 8–9 years, two-thirds of the

growing firms had maintained or increased their employment of RD&D staff while 60% of static or declining firms had reduced their RD&D numbers.

Table 3.5.3 Company growth and change in number of RD&D staff since CID

Change in number full-time RD&D staff	Very fast growing firms	Fast-growing firms	Moderately growing firms	Static and declining firms
Maintained or increased	9 (75%)	4 (57.1%)	5 (62.5%)	4 (40%)
Reduced	3 (25%)	3 (42.9%)	3 (37.5%)	6 (60%)
TOTAL	12 (100%)	7 (100%)	8 (100%)	10 (100%)

As well as employing more in-house design staff, the growing firms made greater use of outside expertise (e.g. design consultants) for product development. There is a highly statistically significant relationship between the use of external design inputs to RD&D and turnover growth (Chi-Square $p=0.006$). All the fastest growing firms used external expertise, whereas most of the static and declining firms did not (see Table 3.5.4).

Table 3.5.4 Company growth and external inputs to RD&D

Use external inputs to RD&D	Very fast growing firms	Fast-growing firms	Moderately growing firms	Static and declining firms
Yes	10 (100%)	6 (60%)	8 (88.8%)	3 (33.3%)
No	0 (0%)	4 (40%)	1 (11.1%)	6 (66.7%)
TOTAL	10 (100%)	10 (100%)	9 (100%)	9 (100%)

Development of New and Improved Products

There is a statistically relationship (Chi-Square $p=0.096$) between the frequency with which the firms introduced new products and their turnover growth (Table 3.5.5), but the relationship is probably interactive and dependent on market sector. For example, product replacement is typically more rapid in consumer sectors and sectors based on new technologies than in mature industrial technologies.

Table 3.5.5 Company growth and new product introduction

Frequency of new product introduction	Very fast and Fast growing firms	Moderately growing and Static /Declining firms
Annually or more	11 (68.8%)	4 (36.4%)
Less than annually	5 (31.2%)	7 (63.6%)
TOTAL	16 (100%)	11 (100%)

Management Attitudes towards Design and Innovation

There was a highly significant relationship between management attitudes and company growth (Table 3.5.6, Chi-Square $p=0.005$). All the growing firms had managers with a positive attitude towards the role of product design (and, where appropriate, innovation) and recognised their importance to the success of the firm now and in the future. By contrast the managers in the declining firms predominantly had a limited and narrow understanding of the contribution of design to the success of the firm.

Table 3.5.6 Company growth and management attitudes

Management attitudes to design and innovation	Very fast and Fast growing firms	Moderately growing and Static /Declining firms
Very positive or positive	20 (100%)	12 (66.7%)
Limited understanding	0 (0%)	6 (33.3%)
TOTAL	20 (100%)	18 (100%)

There was also an interesting relationship between management attitudes to design and innovation and the firms' markets. Managers in firms operating in growing markets had a more positive attitude to design and innovation than those whose firms were in declining markets. This suggests an interactive relationship – with market growth, positive attitudes and company growth reinforcing each other.

3.5.3 Conclusions of the Company-Level Analysis

Among the key conclusion of this section are:

- The fastest growing firms operated in growing markets and had typically developed innovative or niche products, while the declining firms operated in static or declining markets in which they had many competitors.
- The fast-growing firms employed a higher proportion of RD&D staff and had increased their numbers since CID, used external expertise more often for product development and introduced new products more frequently than the slow-growing or declining firms.
- Managers in growing firms had a positive attitude towards design and innovation, whereas those in declining firms tended to have a narrow and limited appreciation of their value.

3.6 Markets, Design and Product Success

The 'selected products' chosen as the focus for the interviews were described in section 3.4.5 and in this section the focus of analysis shifts to the level of these individual products, their commercial success and market position. A function of this analysis was to provide empirical validation of the MADRID Phase 1 findings.

3.6.1 Measuring Product Success

Quantitative product performance

Interviewees were asked to provide data on product sales, exports, profit margin, manufacturing cost, market share and on-going marketing and support costs for the latest 3–4 years. The best data that could be obtained was for sales over 3 years for 20 of the 42 selected products. Product performance was thus measured in terms of sales growth. As previously for company performance, the sample was divided into quartiles, with break points as shown below:

Quartile	Sales performance category	Sales performance over last 3 years	Number of products
1st	Very fast-growing	90% – 306% growth	5
2nd	Fast-growing	30% – 51% growth	5
3rd	Slow growth/slight decline	29% growth – 11% decline	5
4th	Rapid decline	23% – 61% decline	5

Qualitative product performance

As a backup, interviewees were asked to rate their selected product on a 1–5 scale of satisfaction on each of the financial indicators listed above that they considered relevant.

Qualitative performance data was obtained for 40 of the selected products and so quartiles could be created using the means of the satisfaction scores provided, with the most appropriate break points as shown below:

Quartile	Commercial performance category	Mean satisfaction score	Number of products
1st	Very satisfactory	4.2 - 5.0	8
2nd	Satisfactory	3.4 - 4.0	12
3rd	Moderately satisfactory	3.0 - 3.3	10
4th	Unsatisfactory	1.3 - 2.9	10

3.6.2 Product Success and the Product Market

Information was obtained about the nature of the market for the selected product, so its commercial performance could be related to market variables.

Market Growth and Competitiveness

The quantitative data indicated that the products with high rates of sales growth tended to be found in growing markets, while those with slow growing or declining sales were in static or declining markets. This is not very surprising and mirrors the relationship between turnover and market growth at company level.

Also not surprising, is a relationship (although not very strong) between product sales growth and the competitiveness of the product's market – growth being rapid in less competitive markets, and slow or declining in competitive markets.

Market Position

Analysis using the qualitative product performance indicators suggested some further relationships with market variables as indicated by the interviewees' positioning of the selected product on the MADRID market map (described earlier in Section 3.1).

For example, a relationship between the commercial performance of the product and the price/quality-orientation of its market was indicated. Successful products tended to be competing in quality-oriented markets, while less successful products tended to be competing more often in price-sensitive markets. This result is compatible with the above observation about product sales growth and the competitiveness of the market, as competitive markets tend to be more price-oriented. Likewise there appeared to be a relationship between the perceived commercial success of a product and the future market strategy planned for it by the company. Successful products tended to be those for which the company was either satisfied with its market position or planned to increase product quality. In contrast companies often said they planned to reduce the price of the commercially unsatisfactory products in order to improve their competitiveness.

The Competitive Edge

To further explore the nature of competition, interviewees were asked to identify and then rank the factor(s) which they felt gave their selected product a competitive edge over rival products. Table 3.6.1 gives some results comparing the responses from the MADRID survey with those from the earlier CID study.

Table 3.6.1 Factors that give selected product a competitive edge

FACTORS	COMPETITIVE EDGE	MADRID Factor		CID Factor	
		Ranked 1, 2 or 3	Number (Percent)	Ranked 1, 2 or 3	Number (Percent)
PRICE	Purchase Price to end user	13	(16.0%)	32	(13.4%)
	Running Costs to user	2	(2.5%)	NA	
NON-PRICE Product	Functional Performance	14	(17.3%)	43	(18.1%)
	Features (incl. new functions)	1	(1.2%)	NA	
	Ease of Use	4	(4.9%)	11	(4.6%)
	Safety	7	(8.6%)	(included above)	
	Styling/Image/Visual appeal	6	(7.4%)	35	(14.7%)
	Quality (Build, materials, reliability)	13	(16.0%)	43	(18.1%)
	Innovation	2	(2.5%)	NA	
	Exceeds Regulations/Standards	0	(0%)	NA	
Range	Extends Product Range	2	(2.5%)	NA	
	Brand Image	3	(3.7%)	NA	
Company	Response/Delivery time	9	(11.1%)	8	(3.4%)
	Marketing/Sales promotion	0	(0%)	12	(5.0%)
	Customisation	3	(3.7%)	16	(6.7%)
	Company Image	1	(1.2%)	NA	
	After-sales support	1	(1.2%)	7	(2.9%)
	Other (incl. value for money)	NA		31	(13.0%)
TOTALS		81	(100%)	238	(100%)

MADRID = 27 valid responses (out of 42 firms for UK Market); CID = 91 firms (face to face sample)

The results for the competitive edge factors ranked 1 to 3 are remarkably consistent since the CID survey of 8-9 years ago. Functional performance and product quality together with purchase price remain the most important factors in competition. However, there is some evidence of price competition becoming relatively more important, being ranked 1st by 22% of firms compared to 14% at the time of CID. This is not surprising given the recession and increasing intensity of competition. There is also evidence that product styling has become less important while ease-of-use/safety and prompt delivery have become relatively more important since CID. This could be due to the differences in the samples, but is consistent with general trends in competition in which firms have increasingly to compete on price and service quality as well as on product quality and design.

Despite the apparent increasing importance of price factors, an analysis of (rank 1) competitive factors against firm performance shows that the growing firms were competing more on non-price factors than the declining firms which tended to compete more often on price. This statistically significant result supports the above observation concerning product success and price/quality competition.

3.6.3 Market Map Validation

As noted above, interviewees were asked to position their selected products on the MADRID market map and to indicate the direction, if any, in which the company intended to move the product along the price/quality and sales volume axes in order to meet business objectives. An intention was to see if the results of the Phase 1 analysis of the CID data (given in Section 3.1.2) were confirmed by the empirical findings from the MADRID interviews.

Direct comparisons with the Phase 1 market positions were of course only possible in those cases in which the selected product was the same as, or comparable to, the original product studied at the time of CID. Mapping these 21 cases indicated that since CID about 50% of firms had attempted to move their selected product to a more quality-oriented market (see Figure 3.6.1). The exceptions were those products (e.g. cycle locks, hand tools) for which intense competition had forced the firms to move to a more price-sensitive market. Other exceptions were those firms already making high quality products (e.g. electronic instruments, specialist fabrics) who were attempting to increase sales volume while maintaining quality. These observations support the findings of Phase 1 of the research. A few products, where the strategy was simultaneously to reduce price *and* increase quality, could not easily be mapped.

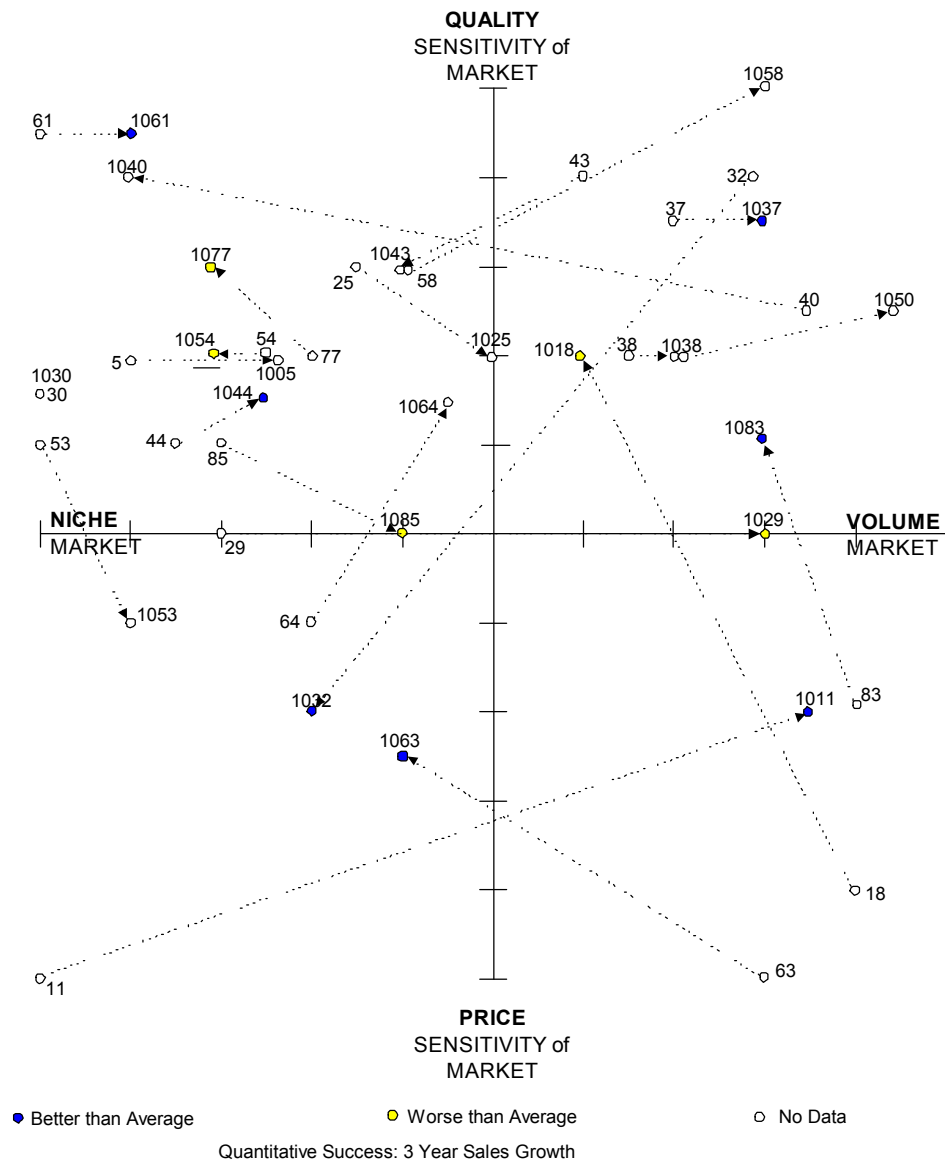


Figure 3.6.1 MADRID market map showing positions and market moves of comparable products since the CID survey.

The ID numbers below 100 (e.g. 61) are the positions given by the research team in Phase 1. ID numbers above 1000 (e.g. 1061) are the positions given by the MADRID interviewees. Arrows indicate the moves in position since CID. Products with above and below average 3 year sales growth rates are indicated.

Confirming the association of quality-oriented market positions/moves with product success, noted in Phase 1, was more problematic. Success was measured in terms of 3 year sales growth rather than payback as in Phase 1 and the 20 MADRID products that could be mapped was too few to come to firm conclusions. Although more products were located by the interviewees in the quality-oriented than the price-sensitive half of the market map, the available data did not indicate a relationship between the price/quality position and the sales growth of the product. Nor for those 13 products for which a direct comparison could be made, did there seem to be a relationship between the shift in market position since the CID survey and product success (Figure 3.6.1).

The above conclusions are of course dependent on the accuracy with which the interviewees were able to position their products on the map having just encountered the technique. It could be argued that the research team was in a better position to map the products based on all the interview information, as was done for Phase 1. Different results might be obtained if this approach had been adopted.

3.6.4 Product Success and Design/Innovation Roles

As with the market mapping, it was intended to use the MADRID interview data to validate the Phase 1 conclusions regarding the roles of design and innovation (listed in Table 3.2.1) in product competition.

Interviewees were asked to rate (on a 5 point scale) the importance of these design and innovation roles for the success of the selected product in its market.

The results were interesting, but disappointing for their intended purpose. It was found that the interviewees tended to rate most of the design/innovation roles as 'important' or 'very important' for their product. The roles with the highest ratings were 'improving functional performance'; 'improving quality' (actual and perceived); and 'reducing manufacturing cost'. However, some roles were considered less important or unimportant, notably 'better styling of packaging'; 'reducing product running cost' and 'radical product innovation'.

Given the high importance rating of most design/innovation roles for most products, it was not surprising that no relationship could be found between particular roles and the commercial success of the products.

Neither did we find clear evidence of different polar profiles, as in Phase 1, for different types of project (e.g. Figure 3.2.3 in Section 3.2). There was, however, some indication from profiles of products whose sales were rapidly declining that such products had involved a narrower approach to design than the more successful ones. This finding, although not conclusive, supports the results of Phase 1.

3.7 Discussion and Conclusions

Market Position and Competition

Since the results of the Commercial Impacts of Design study appeared in the early 1990s, there have been several attempts to measure the commercial benefits of investing in design and new product development in SMEs. None of these studies, however, addressed the question of whether investment in design for product development is dependent on the market in which the firm operates.

Re analysing information from the CID study for the MADRID project indicated that, in commercially successful projects, design had been used either to move products into quality-sensitive markets or, in the case of some high-quality niche market products, to reduce costs and thereby increase sales volume. This finding was partially confirmed by the qualitative results of the MADRID follow-up survey. However, since CID there is some evidence of price competition (and prompt delivery) becoming relatively more important. This is consistent with general trends in competition, in which firms have to compete simultaneously on price as well as on product design and service quality.

Design and Innovation Roles

Another issue neglected in previous research is the contribution that investing in design and innovation makes to product competitiveness. Re analysis of the CID data showed that in commercially successful product development projects more attention had been paid to genuine improvements in product performance, features and build quality than in the loss-making projects, which tended to focus on styling or costs.

In the follow-up MADRID survey all interviewees tended to rate most of the design/innovation roles as 'important' or 'very important' for their product. This indicates that firms now understand that design can contribute more than mere styling or cost reduction. But unfortunately this result also meant that these ratings were not sufficiently differentiated to confirm the findings of the CID re analysis.

Re analysis of CID data also suggested that commercially successful product development projects involved a broad, multi-dimensional approach, while loss-making projects tended to involve a narrow, often styling-oriented, approach to design.

The consistent high rating of design/innovation roles in the MADRID survey indicated an awareness of the value of a multi-dimensional approach, but again prevented reliable confirmation of the above finding.

Overall these responses suggest that managers and designers in SMEs are now *aware* that most factors need to be considered when designing a product but, given the considerable differences in the commercial performance of the products, it is likely that not all firms were equally *effective* in ensuring that these factors were actually taken into account.

Long Term Benefits of Design and Innovation

The final major area examined in MADRID concerns the long-term benefits of investing in product design and innovation. We were surprised to discover that less than 20% of the firms contacted had gone out of business since the original CID survey. This is a good record, given the severe UK recession of the early 1990s, and suggests that SMEs that had sufficient interest in product development to apply for government design support might perform better than more typical firms. Of course these were all firms which had managed to survive their crucial first five years when an estimated 60% of SMEs fail. Nevertheless, several firms, especially in the engineering and building products sectors, had contracted significantly in the recession and many had experienced severe financial problems and one or more changes of ownership.

Other findings of the MADRID survey indicated statistically significant relationships between business success and various measures of long-term investment in design and innovation. Thus, the

firms which had grown rapidly in turnover over the past 5 years employed a higher proportion of RD&D staff, had increased their RD&D staff since CID, more often used external expertise for product development, and introduced new products more frequently, than the slow-growing or declining firms.

There was also a highly significant relationship between management attitudes and company growth. All the growing firms had managers with a positive attitude towards investment in product design (and, where appropriate, technical innovation). By contrast the declining firms predominantly had a limited and narrow understanding of design and innovation and their relevance to the firm.

These findings are in broad agreement with other research in this field. For example, in another major Design Council study, Sentance and Clarke (1997) provided empirical evidence of a positive relationship between the level of design expenditure in different manufacturing industry sectors and their rate of output growth over ten years. Hart and Service (1988) and Service, Hart and Baker (1989) have shown that successful firms, measured in terms of sales turnover growth, had a positive top management attitude towards research, design and development and were committed to the development of innovative products and improved designs.

The MADRID survey provides some encouraging evidence that a number of UK SMEs have moved beyond thinking in terms of financial returns on one-off design and product development projects and have incorporated design 'as an integral part of corporate strategy'. This was one of the aims of the original Support for Design programme which its evaluators (Shirley and Henn, 1988) suggested had not been achieved by the end of the programme.

Design Investment and Business Success

The MADRID project confirms once again that the relationship between investment in design and business performance is complex and interactive. As Gemser (1997) notes, 'successful firms are more likely to have the resources to invest in design than those in financial difficulties'. In other words business success and investments in design and product development are likely to be mutually reinforcing, while poor financial performance and a failure to invest can lead to a cycle of decline.

Finally the analysis supports the conclusions of earlier work (e.g. Walsh et. al, 1992) that investing in design and product development is likely to be a necessary, but not sufficient, condition for good business performance. This research has indicated how important the market context can be in influencing growth rates, with the fastest growing firms using design to create products for markets that offer opportunities for growth. It has also indicated that different product and market strategies may be required to enable firms to generate new employment as well as grow in sales and profits. Firms that grow in both size and turnover seem to be those that operate in, or can move into, a growing market, preferably with products tailored to a market niche or with innovative products that create or meet a market demand.

REFERENCES

- Baker, M.J. (1994) *The Marketing Book*, (Third Edition), Butterworth Heinemann, Oxford.
- Brown, R. (1993) *Market Focus. Achieving & Sustaining Marketing Effectiveness*, Butterworth Heinemann, Oxford.
- Bruce, M., Potter, S. and Roy, R. (1995) The risks and rewards of design investment, *Journal of Marketing Management*, Vol. 11, pp. 403-417.
- Buzzell, R.D. and Gale, B.T. (1987) *The PIMS Principles. Linking Strategy to Performance*, The Free Press, New York.
- Croft, M.J. (1994) *Market Segmentation. A Step-by-step Guide to Profitable New Business*, Routledge, London.
- Department of Trade and Industry (1996) *Small firms in Britain*, Small Firms Statistical Unit, Sheffield.
- Gardiner, J.P. (1995) Price & Non-Price Competition. A Case Study of the Portable Power Tool Industry, Unpublished Internal Document, The Open University, Milton Keynes.
- Gemser, G. (1997a) Industrial design for competitiveness *Paper for Second European Academy of Design conference*, Stockholm, Sweden 23-25 April.
- Gemser, G. (1997b) Concurrenren door investeren in industrieel ontwerpen (Competing by investing in industrial design), School of Management, Erasmus University, Rotterdam.
- Groupe Bernard Juilhet (1995) Le PMI françaises et le design, Paris, October.
- Hart, S.J. and Service, L.M. (1988) The effects of managerial attitudes to design on company performance, *Journal of Marketing Management*, Vol. 4 No. 2, Winter, pp. 217-229.
- Jacoby, J. and Olsen, J. (eds.) (1985) *Perceived Quality*, Lexington Books, Lexington, MA.
- Kotler, P. (1988) *Marketing Management. Analysis, Planning, Implementation and Control* (Sixth Edition), Prentice Hall, Englewood Cliffs.
- Porter, M. (1980) *Competitive Strategy*, Free Press, New York.
- Potter, S., Roy, R., Capon, C.H., Bruce, M., Walsh, V.M. and Lewis, J. (1991) The Benefits and Costs of Investment in Design. Report DIG-03, Design Innovation Group, The Open University and UMIST, Milton Keynes.
- Riedel, J.c.k.h., Roy, R. & Potter, S. (1996a) Mapping the Market – The MADRID Market Map, Working Paper WP-17, Design Innovation Group, The Open University, Milton Keynes.
- Riedel, J., Roy, R and Potter, S. (1996b) Investment in Design: A Market Analysis using the MADRID map. In *Proceedings 8th. International Forum on Design Management Research and Education*, Vol. 2, Design Management Institute, Boston.
- Roerdinkholder, F.A. (1994/5) Economische waarde van ‘Goed Industrieel Ontwerp, Netherlands Design Institute, Amsterdam.
- Rothwell, R. & Gardiner, P. (1984) The Role of Design in Competitiveness. In Langdon, R. (ed.) *Design Policy: Design and Industry*. Design Council, London, pp. 11-23.
- Roy, R. and Potter, S. (1993) The commercial impacts of investment in design, *Design Studies*, Vol. 14 No. 2, April, pp. 171-193.
- Roy, R. and Riedel, J.c.k.h. (1996a) The Role of Design and Innovation in Product Competition, Working Paper WP-18, Design Innovation Group, The Open University, Milton Keynes.
- Roy, R. and Riedel, J. (1997) Design and innovation in successful product competition, *Technovation*, Vol. 17 No. 10, October, pp. 537-548.
- Sentance, A. and Clarke, J. (1997) *The Contribution of Design to the UK Economy*, The Design Council, London, June.
- Service, L.M., Hart, S.J. and Baker, M.J. (1989) *Profit by Design*, The Design Council, London.
- Shirley, R and Henn, D (1988) *Support for Design : Final evaluation report*, Assessment Unit, Research and Technology Policy Division, Department of Trade and Industry, London, June.
- Utterback, J.M. (1994) *Mastering the Dynamics of Innovation*. Harvard Business School Press, Boston, Massachusetts.

- Walsh, V., Roy, R., Bruce, M. and Potter, S. (1992) *Winning by Design: Technology, Product Design and International Competitiveness*, Blackwell, Oxford.
- Wray, G.R. (1991) Design or Decline—a national emergency. *Proceedings Institution of Mechanical Engineers*, Vol. 205, Part B, pp. 153–170.

APPENDIX

Future Research Priorities

This report only includes a selection of the results from the MADRID project. There is a considerable amount of additional data available and still to be analysed.

Further Analysis to be Undertaken

Phase 1

Analysis of design/innovation roles in different quadrants of the market map to identify any relationships between the market positions and moves in position and the roles of design and innovation.

Phase 2

Further analysis at both company and product levels, including:

- (a) Analysis, and statistical testing, of firm turnover growth rates against:
 - Industry sectors of firms;
 - Evolution of the firms' product portfolios since CID;
 - Changes in design/product development approaches and techniques;
 - Strategic role of design and innovation in the success of the firm;
 - The importance of different types of design (e.g. engineering, industrial) to the success of the firm.
 - Investment in RD&D during the recession;
- (b) Analysis of firm employment and productivity growth rates against several variables e.g. the nature of the market; design management characteristics.
- (c) Sales growth and qualitative commercial performance of the 'selected product' analysed against:
 - Design role polar maps for different product types;
 - Constraints affecting development of the selected product.

Future Research

- Development of short case studies of successful firms and projects (including those which grew rapidly in difficult markets) to show how design fits into company strategy; the relationships of design and production, management attitudes; qualifications of RD&D staff; approaches to product development, etc. It may be necessary to revisit some of these firms in order to produce the case studies.

- In order to confirm the Phase 1 findings on the relationships between product performance, market position and design/innovation roles from a follow-up empirical survey a different approach may be required from that adopted in MADRID Phase 2.

In Phase 1 the research team positioned the products on the market map, and judged the effectiveness of the firms in considering different design/innovation roles, using the information in the CID database. Such team judgement is arguably more reliable than relying on individual interviewees' immediate responses to these tasks. This could be the subject of further work based on an assessment by the research team of market positions and design/innovation roles for the selected products followed by validation by interviewees in the companies concerned.

- Another main area for further work would be to undertake a survey of competitor firms, including larger firms and projects which had not received government design support, as originally proposed but not carried out in this study. This would help confirm the general validity of the findings of this research.

Confidentiality

The financial information in both the CID and MADRID projects was obtained on the basis that only aggregated data would be published and the financial results from individual firms and projects would not be divulged outside of the research team. Only where express permission was given for illustrative purposes has financial data on individual projects been quoted.

MADRIDFnlRptDesC7.98